Retentive Characteristics of Overdenture Attachments During Repeated Dislodging and Cyclic Loading

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The retentive and morphologic changes of overdenture attachments were evaluated independently after repeated insertion and sinusoidal loading on implant abutments. Stud and magnetic attachments were embedded in overdenture housings (n = 5). The overdentures were subjected to either repeated insertion and removal for 5,400 cycles or sinusoidal cyclic loading for 100,000 cycles. A 67.8% decrease in retentive force was observed after 100,000 loading cycles ($P < .05$), and a 73.9% decrease of retentive force occurred after 5,400 insertion-removal cycles ($P < .05$). Stud attachments showed more loss of retention and physical deterioration than magnetic attachments tested under identical conditions. *Int J Prosthodont 2011;24:127–129.*

Stud attachments generate high retentive forces and induce low bending moments. Magnetic attachments retain overdentures well over time but provide less retention than stud attachments.[1] It is hypothesized that physical degradation may account for differences in retention between studs and magnets. The objective of this study was to evaluate and compare the degradation of stud and magnetic attachments.

Materials and Methods

Two parallel Brånemark System implants (Mk III Groovy RP, 4.0 × 13 mm; Nobel Biocare) were placed 22 mm apart in the left and right canine areas of dental stone casts using a surveyor (Ney Surveyor, Dentsply).[2] Implants were placed at a similar distance to what would be observed between two natural canine teeth. Mandibular implant-supported overdentures were constructed using light-cured denture base resin (Triad, Dentsply). A stud attachment (Locator, Zest Anchors) and two neodymium-iron-boron alloy magnetic attachments (Magnedisc 800, Aichi Steel; Neomagnet, Attachments International) were placed on the implants and metal housings, with the retentive components embedded in the overdentures according to the manufacturers' instructions.

Repeated insertion and removal of the overdentures (n = 5) for 5,400 cycles was conducted using a servohydraulic testing machine (Model 8511, Instron) in a 37°C water bath at 0.2 Hz. For the cyclic loading test, the overdentures (n = 5) were loaded sinusoidally in a coil cycler electromechanical fatigue machine (Proto-Tech) at 2 Hz for 100,000 cycles from 0 to 78 N in a 37°C water bath. Vertical tensile dislodging forces were captured at a cross-head speed of 50 mm/min after a specific number of cycles of repeated dislodging or cyclic loading.

To evaluate attachment degradation, tested specimens were examined using a stereoscopic microscope (Vision Stereo Microscope, LW Scientific). All Locator attachments were sectioned using a low-speed diamond saw (IsoCut Wafering Blade, Buehler) to observe degradation at a magnification of 60×.

Statistical analyses of peak load-to-dislodgement forces were completed using a two-way analysis of variance (ANOVA) procedure. The Scheffé test was used for all post hoc pairwise comparisons at a 95% confidence level.

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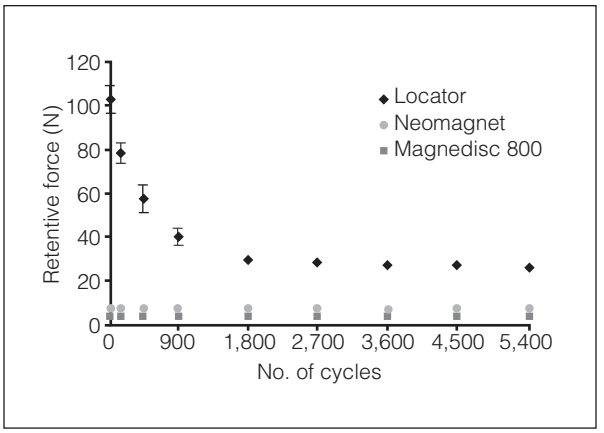

Fig 1 Mean values of retentive forces as a function of repeated insertion and removal of tested attachments and number of cycles.

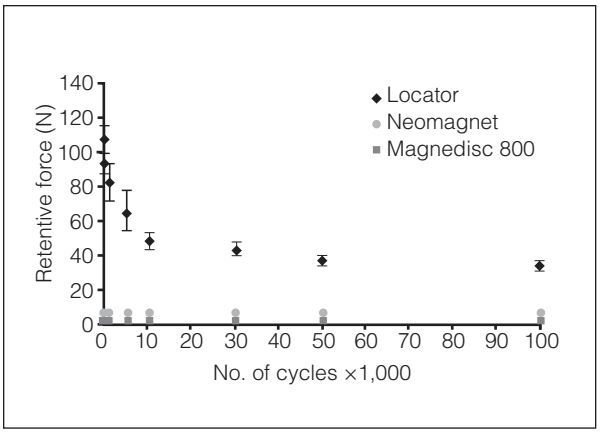

Fig 2 Mean values of retentive forces as a function of cyclic loading of tested attachments and number of cycles.

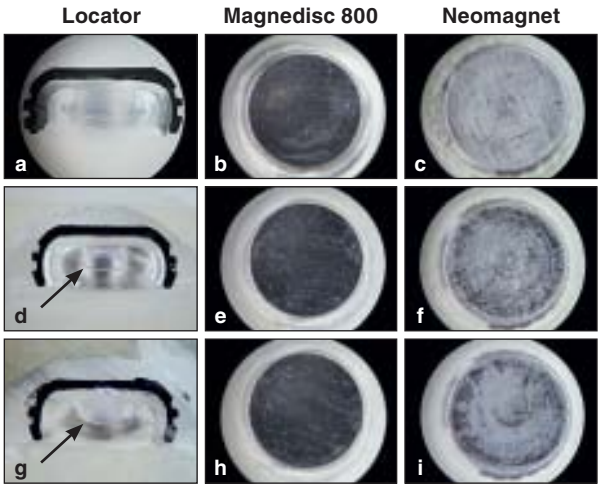

Fig 3 (a to c) Representative new components at baseline and worn components after **(d to f)** 50,000 and **(g to i)** 100,000 cyclic loadings with 78 N. Arrows indicate deteriorations of the core post plastics.

Results

After 5,400 cycles of continuous insertion and removal, the retentive force for the Locator attachments was 26.8 ± 0.9 N, a 73.9% decrease compared to the initial value (Fig 1). After sinusoidal loading, retentive forces decreased 67.8% (Fig 2). The decreases in retention of the Locator attachments after repeated dislodging or cyclic loading were significantly greater than that for magnet attachments ($P < .05$). No significant changes in retentive force were observed for magnet attachments after repeated dislodging or cyclic loading ($P > .05$). Microscopic examination of the Locator attachments revealed worn core male components and degradation of the female resilient inserts, consistent with the loss of retention (Fig 3). Abrasion of the magnetic attachment surface is clearly increased by cyclic loading.

Discussion

The methodology used in the current study was designed to simulate clinical use of an implant-supported overdenture. By some published comments, 5,400 insertion-removal cycles simulates 3 years of in vivo wear based on an average of 5 cycles/day, which is long enough to detect the need for attachment replacement.[3] Cyclic loading with 78 N for 100,000 cycles has been reported to correlate with a 1-year service period.[4] A 70% loss of retention was observed after 1,800 cycles of repeated insertion and removal, which would correlate with approximately 1 year of clinical service. In spite of the drop in retention, the Locator attachments retained a six- and fourfold higher retention at the end point than Neomagnet and Magnedisc attachments, respectively (Fig 1). Similar relationships were observed

after cyclic loading (Fig 2). Visual deteriorations of the core-post resilient inserts were consistent with the loss of retention for Locator attachments. Repeated insertion and removal seemed to have more of an effect on the degradation of stud attachments than masticatory loading. However, both parameters must be considered in evaluating the degradation process in stud attachment systems.

Overall, the retentive properties of magnetic attachments were not affected by the number of loading cycles, and retention was preserved throughout the testing period. A minimum of 20 N has been suggested for optimum overdenture retention.[5] Although significant wear was observed on the Locator attachments after a simulated 3 years of use, they still provided higher levels of retention compared to magnetic attachments.

Conclusion

Under the conditions of this in vitro investigation, the results indicate that the mechanical attachments tested were more susceptible to loss of retentive force than magnetic attachments. Further clinical investigations are needed to determine the correlation between the force measurements employed and their ongoing role in a dynamic biologic environment.

Acknowledgments

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Literature Abstract

High prevalence of obstructive sleep apnea among patients with head and neck cancer

The purpose of this prospective study was to determine the prevalence of obstructive sleep apnea (OSA) among consecutive patients with cancer of either the oral cavity or oropharynx prior to undergoing primary surgical resection. The secondary objective was to determine if patients with OSA are at an increased risk of postoperative cardiopulmonary and other OSA-related morbidities. Seventeen patients were recruited for this overnight polysomnography study (sleep study) 2 to 14 days prior to their scheduled surgery. A portable recording system was used in the patient's home for the OSA evaluation. An apnea-hypopnea index (AHI) of ≥ 20 events per hour was considered OSA. The hospital charts of all study patients were reviewed by an investigator unaware of the subjects' OSA status to determine the postoperative course for the period up to 60 days following surgical resection. Length of stay in an intensive care unit or in a monitored setting, hours on a ventilator, and number of cardiopulmonary and other OSA-related postoperative complications were reviewed. Outcome variables were compared between OSA and non-OSA groups using an unpaired *t* test or a Fisher exact test. Results show that 13 of 17 (76%) patients had OSA. Overall, postoperative complications, defined as prolonged intensive care unit stay (greater than 24 hours), need for mechanical ventilation, and cardiopulmonary morbidities, were observed in 67% of OSA patients compared to 2% of non-OSA patients. One limitation of this study included the use of a higher AHI cut off for OSA compared to the currently acceptable standard of ≥ 5. Another limitation was the small number of subjects, which does not have good secondary validity to the actual oral and oropharynx population in Montreal, Canada. The study concludes that the prevalence of OSA in patients with cancer of the oral cavity and oropharynx prior to primary surgical resection is significantly higher than that in the general population. Another finding was that the tendency for postoperative complications is more common among patients with OSA.

Payne RJ, Hier MP, Kost KM, et al. *J Otolaryngol* 2005;34:304–311. **References:** 53. **Reprints:** Dr Michael P. Hier, 3755 Cote Street, Catherine, Suite E209, Montreal, QC H3T 1E2. Email: mhier@ent.jgh.mcgrill.ca—*Alvin G. Wee, Omaha, NE*